Remarks

In the official action, the Examiner allows, or indicates as being allowable, all of the claims, save one. The one claim that is not allowed is claim 21 that the Examiner rejects on clarity grounds and on prior art grounds. These grounds for rejection are respectfully traversed.

It is submitted that the term "plano-convex" is very well known in the lens art although it is not believed that the term has been used previously in connection with Rotman lenses.

In any event, enclosed herewith is an article found on the Internet at http://optics.mellesgriot.com/opguide/fo_4.htm that discusses fundamental optics and it includes a drawing of a conventional plano-convex lens. Note that a plano-convex lens has a planar surface that confronts a convex surface. The drawing shows rays transiting the lens which pass through both surfaces.

The Examiner rejected claim 21 based upon Figure 3 of US Patent No. 5,936,588 to Rao. The Examiner asserts that Rao, pointing to Figure 3, has a substantially planar flat side. It is assumed that the Examiner is referring to a side of Rao's device in the plane of the paper on which the Figure appears since the confronting surfaces of Rao's lens all appear to be convex. In short, he has no planar surface confronting a convex surface at least so far as the term "plano-convex" is used in the lens art.

As such, it is submitted that Rao does not teach a plano-convex Rotman lens since there is no planar end confronting a convex end as is seen in plano-convex lenses.

In a spirit of cooperation, claim 21 has been amended herein to basically repeat the preamble limitation "plano-convex" after the word "having." As such, claim 21 now recites "a plano-convex Rotman lens having a planar end disposed confronting a convex end thereof." Rao et al. shows no such structure. This amendment does not affect the scope of claim 21, but rather simply restates the preamble limitation after the

word "having."

Reconsideration of this application as amended is respectfully requested.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 12-0415. In particular, if this response is not timely filed, then the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136 (a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 12-0415.

I hereby certify that this correspondence is being deposited with the United States Post Office with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, PO Box 1450, Alexandria, VA 22313-1450 on

May 12, 2005

(Date of Deposit)

Corinda Humphrey

(Name of Person Signing)

(Signature)

May 12, 2005

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Respectfully submitted,

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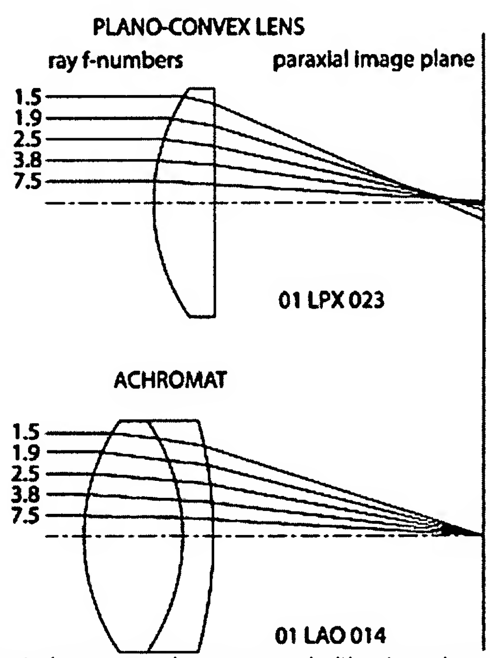
This situation can be improved by using a two-element system. The second part of the figure shows a precision achromat (01 LAO 014), which consists of a positive low-index, crown-glass element (shown in blue) cemented to a negative meniscus high-index, flint-glass element (shown in yellow). This is drawn to the same scale as the plano-convex lens. No spherical aberration can be discerned in the lens. Of course, not all of the rays pass exactly through the paraxial focal point; however, in this case, the departure is measured in micrometers, rather than in millimeters, as in the case of the plano-convex lens. Additionally, chromatic aberration (not shown) is much better corrected in the doublet. Even though these lenses are known as achromatic doublets, it is important to remember that even with monochromatic light the doublet's performance is superior.



Single element plano-convex lens compared with a two-element achromat

The figure also shows the f-number at which singlet performance becomes unacceptable. The ray with f/# = 7.5 practically intercepts the paraxial focal point, and the ray with f/# = 3.8 is fairly close. This useful drawing, which can be scaled to fit a plano-convex lens of any focal length, can be used to estimate the magnitude of its spherical aberration, although lens thickness

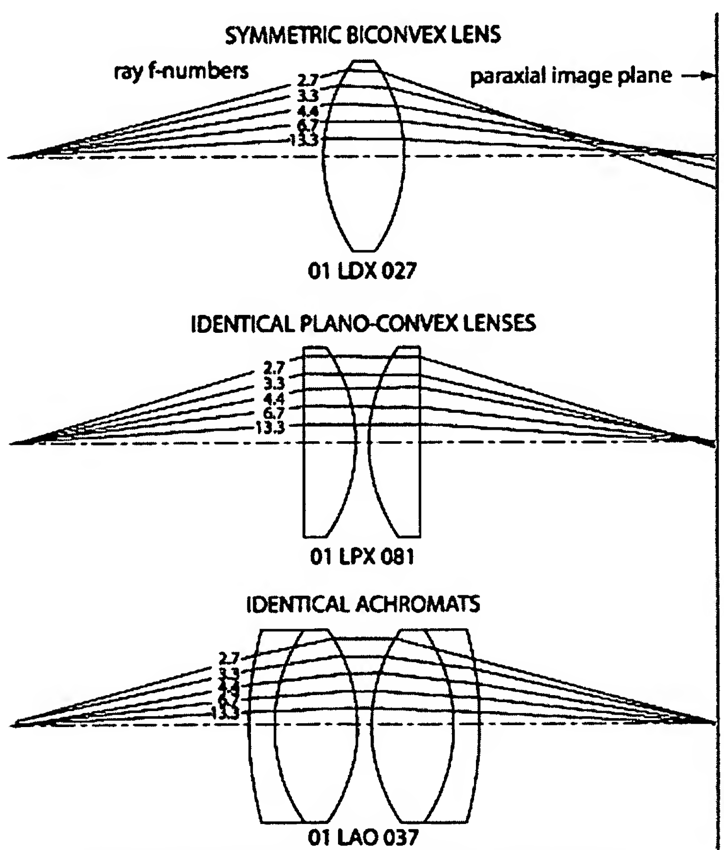
affects results slightly.

Unit Conjugate Ratio

The figure below shows three possible systems for use at the unit conjugate ratio. All are shown to the same scale and using the same ray f-numbers with a light wavelength of 546.1 nm. The first system is a symmetric biconvex lens (01 LDX 027), the best-form singlet in this application. Clearly, significant spherical aberration is present in this lens at f/# = 2.7. Not until f/# = 13.3 does the ray closely approach the paraxial focus.

A dramatic improvement in performance is gained by using two identical plano-convex lenses with convex surfaces facing and nearly in contact. Those shown are both 01 LPX 081. The combination of these two lenses yields almost exactly the same focal length as the biconvex lens. To understand why this configuration improves performance so dramatically, consider that if the biconvex lens were split down the middle, we would have two identical plano-convex lenses, each working at an infinite conjugate ratio, but with the convex surface toward the focus. This orientation is opposite to that shown to be optimum for this shape lens. On the other hand, if these lenses are reversed, we have the system just described but with a better correction of the spherical aberration.

We have shown that an achromat is superior in performance to a singlet when used at the infinite conjugate ratio and at low f-numbers. Since the unit conjugate case can be thought of as two lenses, each working at the infinite conjugate ratio, the next step is to replace the plano-convex singlets with achromats, yielding a four-element system. The third part of the figure shows a system composed of two 01 LAO 037 lenses. Once again, spherical aberration is not evident, even in the f/# = 2.7 ray.



Three possible systems for use at the unit conjugate ratio

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